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# BITTERBRUSH TOPPING: SHRUB RESPONSE AND COST FACTORS

Robert B. Ferguson



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INTERMOUNTAIN FOREST AND RANGE  
EXPERIMENT STATION  
Ogden, Utah 84401

*COVER PHOTO: A forestry technician uses a lightweight chain saw to "top"  
overmature bitterbrush near Irish Creek, Boise National Forest.*

# **BITTERBRUSH TOPPING: SHRUB RESPONSE AND COST FACTORS**

**Robert B. Ferguson**

Research conducted cooperatively by Intermountain Forest and Range Experiment Station, USDA Forest Service, Ogden, Utah, and the Idaho Fish and Game Department through Federal Aid to Wildlife Restoration Project W-111-R.

INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION  
Forest Service  
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The following people supervised the topping operations: BOISE NATIONAL FOREST — Hugh G. Pangman and Joseph D. Argyle, former District Ranger and former Assistant District Ranger, respectively, Cottonwood Ranger District; MODOC NATIONAL FOREST — Chester D. Cannon and James C. Gordon, former District Ranger and former Range Conservationist, respectively, Doublehead Ranger District; SAWTOOTH NATIONAL FOREST — George B. Fry, former District Ranger, Twin Falls Ranger District, and Thomas A. Phillips, Range Conservationist.

The following personnel assisted in collecting data: BOISE NATIONAL FOREST — Darwin R. Jensen, former Range Conservationist, Ervol I. Sheffield, Fire Control Officer, Abb H. Taylor, Range Conservationist, and William L. Thompson, former Assistant District Ranger, Cottonwood Ranger District; MODOC NATIONAL FOREST — Dewey G. Riscioni, Assistant District Ranger, Doublehead Ranger District, Sherwood L. S. Stutz, Wildlife Biologist, and Ray L. Ward, Range Conservationist; SAWTOOTH NATIONAL FOREST — Roderick R. Howard, former Range Conservationist, William J. Little, former Range Conservationist, Lewis A. Munson, District Ranger, Twin Falls District, and Donald J. Proctor, Range Conservationist; PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION — Donald L. Neal, Range Scientist, and Thomas F. Newman, Wildlife Biologist; IDAHO FISH AND GAME DEPARTMENT — Gary R. McNeill, Regional Game Manager; INTERMOUNTAIN STATION — Douglas G. Mefford, former Range Research Technician, and Thomas E. Olsen, former Range Aid.

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## **ABSTRACT**

Methods of topping overmature bitterbrush shrubs and the subsequent effect on annual twig growth were studied on three widely separated deer winter ranges. Annual twig growth increased considerably following topping, then gradually decreased, although it remained greater than on untopped shrubs during the 4 years of study. No detrimental effects on shrub longevity, nor increase in damage from insect attack or disease were observed. Chain saws were more efficient than hand tools for topping. Using chain saws, an efficient crew should be able to top a stand of bitterbrush, similar in density to those described, for \$9.00 to \$21.00 per acre.

## INTRODUCTION

Bitterbrush, *Purshia tridentata* (Pursh) DC., a deciduous shrub native to much of the Intermountain West, generally is an important component of the winter diet of deer. From 1959 to 1963, an exploratory study was conducted near Boise, Idaho, to determine the effect of topping on subsequent annual twig production of overmature bitterbrush shrubs (Ferguson and Basile 1966). Removal of a considerable portion of the shrub canopy resulted in a substantial increase in annual twig production.

As a followup to this initial effort, a more comprehensive study was planned to evaluate shrub response under a wider variety of environmental conditions. Also, methods of topping and the economic feasibility of large-scale topping projects were assessed.

In the spring of 1966, the Boise, Modoc, and Sawtooth National Forests participated with the Intermountain Forest and Range Experiment Station in a field test of the topping technique. This paper reports on both shrub response and factors affecting the cost of topping. Some observations on shrub longevity and the effect of repetitive topping are also presented.

## METHODS

The purpose of topping is to stimulate profuse twig growth from live branches below the level at which the old shrub is cut off. The treatment was applied only once, and the magnitude of twig production assessed following each of the subsequent four growing seasons.

Figures 1 through 3 illustrate the three study areas and table 1 tabulates descriptive information about them. The overmature bitterbrush shrubs (those that have reached an age at which annual twig production is small compared to that of young shrubs) were slightly larger in height and canopy spread on the Boise site than on either of the other study sites. Shrubs on the Modoc area tended to branch more from the base and, on the whole, were more vigorous. Many of the old shrubs on the Sawtooth area were of small stature, possibly because they were growing along a ridge site.

Topping was accomplished the last week of March 1966 on the Boise and Sawtooth sites, and during the third week in April on the Modoc. Treatment was completed before flower buds developed. (New twig growth does not begin on bitterbrush until the flowering stage is nearly complete.) Approximately 10 acres were treated at each site.

Each study area was divided into four sections. Lightweight, direct drive chain saws were used on two sections and lopping shears on the alternate two sections. Overmature shrubs, 5 to 7 feet tall, were cut off 3 to 4 feet above the ground. Smaller overmature shrubs, more common on the Sawtooth site, were cut so as to remove about one-half of the canopy volume. All shrubs were cut on a horizontal plane through the canopy.

Prior to topping, 20 shrubs were chosen at random from the stand on each study area. These old shrubs were randomly divided and assigned to either the topped or the control shrub group. The topped shrubs were cut at the time the stands were treated. All sample shrubs were marked by numbered aluminum tags and plastic flagging. Following topping, a complete count was made of all shrubs on each study area.

At the end of each growing season (1966 through 1969), all annual twigs 0.2 inch long or longer were measured on two branches of each sample shrub. Measurements were started at a point where the diameter of the branch was approximately 1 inch. These branches had also been selected and tagged prior to topping to preclude bias in their selection. The same branches were remeasured each year, unless flagging and tags had been torn off by deer or a branch had died. In these few instances, new sample branches were chosen.

*Figure 1.--Boise study area, Boise National Forest, Boise County, Idaho.*



Each fall, an estimate was also made of the percent of the entire canopy made up by the two sample branches. For example, if the total twig growth on the two branches of a particular shrub was 300 inches, and the estimator believed that these two branches made up 10 percent of the entire shrub, then there might be about 3,000 linear inches of twig growth on that shrub.

The percent dead canopy of each sample shrub was estimated to the nearest 10 percent prior to topping, and was reestimated each year thereafter.



*Figure 2.--Sawtooth study area, Sawtooth National Forest, Twin Falls County, Idaho.*

Figure 3.--Modoc study area,  
Modoc National Forest,  
Modoc County, Calif.



Data obtained annually from the sampled shrubs on each study area were tested for homogeneity of variance by Bartlett's test. When variance was not homogeneous, a *t* test described by Steel and Torrie (1960) was used to test for significant difference between means. When variance was homogeneous, the *t* test described by Dixon and Massey (1951) was used.

Use of the estimated percent of shrub canopy comprised of the two measured branches permitted a calculation of the annual growth for each sample shrub.

Table 1.--Descriptive features of three study areas used to assess the effects of  
topping overmature bitterbrush shrubs

| Study area | Location                            | Elevation   | Aspect and slope | Soil parent material | Annual precipitation | Mean no. shrubs topped per acre |
|------------|-------------------------------------|-------------|------------------|----------------------|----------------------|---------------------------------|
|            |                                     | <i>Feet</i> |                  |                      | <i>Inches</i>        |                                 |
| Boise      | 18 miles east of Boise, Idaho       | 3,400       | SE, 5-30%        | Granite              | 18                   | 155                             |
| Sawtooth   | 18 miles south of Twin Falls, Idaho | 5,800       | SE, 0-20%        | Rhyolite             | 11                   | 220                             |
| Modoc      | 20 miles south of Tule Lake, Calif. | 4,300       | Level            | Basalt               | 11                   | 546                             |

## **RESULTS**

### **Annual Twig Production**

The response to topping was similar to that observed in earlier work (Ferguson and Basile 1966). Twig production on the branches sampled increased severalfold the first growing season after topping, then decreased each succeeding year (table 2).

The data on inches of twig growth can be roughly converted to oven-dry weight by using a factor of 0.0809 pound per 1,000 inches of twig growth. This factor represents the mean of 19,600 twigs collected from 1,490 shrubs in southern Idaho. By using the mean shrub density (table 1) and the calculations of total twig growth per shrub, the pounds of forage produced per acre can be calculated. Table 3 shows productivity per acre (assuming either that all shrubs were untopped or that all were topped) and the gain in pounds per acre that resulted from topping.

### **Cost Per Acre**

The cost of topping a bitterbrush stand will depend on a number of variables:

- 1.--Wages of personnel assigned to the work;
- 2.--experience of workers in the use of tools, particularly, the chain saw;
- 3.--dependability of workers in doing assigned work efficiently and conscientiously;
- 4.--density and size of overmature shrubs;
- 5.--roughness of the terrain;
- 6.--availability of lightweight chain saws and protective apparel; and
- 7.--distance to and from work.

Interaction of the first five of the above factors is reflected in the data shown in table 4 for the three sites treated in 1966. On the Modoc site, calculated cost per acre was \$18.56 when topping was done by chain saws and \$33.50 when lopping shears were used. Calculations included all costs charged to the project, including travel time. In this case, saws and protective apparel were available. If \$3.75 per man-hour is used as a reasonable wage, topping could cost from \$20.62 to \$35.62 per acre when lopping shears are used. If chain saws are employed, topping could cost from \$9.00 to \$21.00 per acre. Most likely, the cost per acre will depend primarily upon the worker's skill in handling and servicing equipment and upon the density of shrubs to be cut.

Table 2.--Mean twig growth on sample branches of 10 topped and 10 control bitterbrush shrubs over four growing seasons and the ratio of topped to control shrubs

| Year          | : Topped <sup>1</sup> | : Standard : deviation : | : Control : Standard : deviation : | : Ratio |
|---------------|-----------------------|--------------------------|------------------------------------|---------|
| <i>Inches</i> |                       |                          |                                    |         |
| <i>Inches</i> |                       |                          |                                    |         |
| BOISE         |                       |                          |                                    |         |
| 1966          | 389**                 | 196                      | 75                                 | 97      |
| 1967          | 358                   | 242                      | 155                                | 352     |
| 1968          | 186                   | 104                      | 111                                | 125     |
| 1969          | 166                   | 103                      | 145                                | 231     |
| SAWTOOTH      |                       |                          |                                    |         |
| 1966          | 296**                 | 147                      | 48                                 | 55      |
| 1967          | 187**                 | 74                       | 45                                 | 55      |
| 1968          | 95**                  | 49                       | 32                                 | 45      |
| 1969          | 188                   | 146                      | 112                                | 113     |
| MODOC         |                       |                          |                                    |         |
| 1966          | 541*                  | 337                      | 225                                | 102     |
| 1967          | 768**                 | 430                      | 332                                | 118     |
| 1968          | 183                   | 163                      | 120                                | 96      |
| 1969          | 239                   | 241                      | 154                                | 145     |

<sup>1</sup>Asterisks denote significantly greater production than control shrubs (\*\* = 0.01 level, \* = 0.05 level).

Table 3.--Pounds per acre of forage (ovendry) produced, assuming either topping or no topping, and the increase in available forage that resulted from topping

| Year     | : No shrubs : topped | : All shrubs : topped | : Gain from : topping |
|----------|----------------------|-----------------------|-----------------------|
| BOISE    |                      |                       |                       |
| 1966     | 12                   | 84                    | 72                    |
| 1967     | 11                   | 61                    | 50                    |
| 1968     | 19                   | 35                    | 16                    |
| 1969     | 32                   | 34                    | 2                     |
| SAWTOOTH |                      |                       |                       |
| 1966     | 5                    | 56                    | 51                    |
| 1967     | 5                    | 33                    | 28                    |
| 1968     | 3                    | 16                    | 13                    |
| 1969     | 8                    | 44                    | 36                    |
| MODOC    |                      |                       |                       |
| 1966     | 75                   | 180                   | 105                   |
| 1967     | 77                   | 388                   | 311                   |
| 1968     | 36                   | 76                    | 40                    |
| 1969     | 42                   | 79                    | 37                    |

Table 4.--*Man-hours of work per acre and number of shrubs topped per man-hour on three study areas, 1966*

| Study area          | Topping method |                         |            |
|---------------------|----------------|-------------------------|------------|
|                     | Lopping shears | Chain saws <sup>1</sup> |            |
|                     |                | Cutting time            | Total time |
| MAN-HOURS PER ACRE  |                |                         |            |
| Boise               | 5.5            | 1.3                     | 2.4        |
| Sawtooth            | 6.4            | 1.6                     | 3.9        |
| Modoc               | 9.5            | 3.1                     | 5.6        |
| SHRUBS PER MAN-HOUR |                |                         |            |
| Boise               | 30             | 112                     | 61         |
| Sawtooth            | 36             | 133                     | 55         |
| Modoc               | 50             | 201                     | 109        |

<sup>1</sup>Total time includes time required for saw maintenance and for somewhat more frequent rest periods than when shears were used.

### Effects on Shrub Condition

Four and one-half years after the topping treatment none of the sample shrubs were dead, and no obvious shrub mortality had occurred in the treated stands. Estimates of the percent of dead canopy indicated no appreciable differences between topped and control shrubs (table 5).

Table 5.--*Mean percent dead canopy<sup>1</sup> of topped and control bitterbrush shrubs before topping and four growing seasons later*

| Study area | Topped shrubs |         | Control shrubs |         |
|------------|---------------|---------|----------------|---------|
|            | March         | October | March          | October |
|            | 1966          | 1969    | 1966           | 1969    |
| Boise      | 6.0           | 13.0    | 10.0           | 10.5    |
| Sawtooth   | 8.0           | 18.0    | 3.5            | 24.0    |
| Modoc      | 10.0          | 20.0    | 10.0           | 25.0    |

<sup>1</sup>Based on estimated percent dead canopy of 10 topped and 10 control shrubs at each location.

## **DISCUSSION**

### **Shrub Response**

The response of overmature bitterbrush shrubs to topping on the three widely separated sites substantiated the previous findings of the 1960 tests near Boise. Environmental conditions in a particular year will affect overall shrub response on each site. Variation in the vigor of individual old shrubs will result in obvious differences in total amount of twig growth produced following topping.

Some twigs produced on tall, overmature bitterbrush shrubs are above the reach of deer. Thus, the calculated amounts of available forage shown for an untopped stand in table 3 are somewhat liberal. On the other hand, for several years following topping, virtually all twig production is available to deer. Of the three study areas involved, the Boise site probably had the highest proportion of tall shrubs. Shrubs on the Sawtooth site were generally smaller than those on either the Boise or the Modoc site.

If the sample shrubs were representative of the productivity of most shrubs on the three study areas, the Modoc site was by far the most productive (table 3). A bitterbrush stand such as that on the Modoc may not appear to need treatment to increase available forage. However, the Modoc results indicate the large increase in browse production possible from shrubs growing on a favorable site. At the other extreme, a stand similar to that on the Sawtooth site may be producing relatively small amounts of browse; so the increase in production that follows topping becomes important to wintering deer. Any decision as to whether or not topping is a justifiable practice will depend on how badly additional forage is needed on a particular portion of winter range. Certainly, more winter forage will be obtained per dollar invested on an area that has a high density of old shrubs than on an area that has only a scattering of old shrubs.

A single vigorous shrub on the Boise site produced a large proportion (74, 36, and 52 percent) of the total growth measured on the control shrubs for the years 1967, 1968, and 1969, respectively. The large twig production of this one shrub resulted in a large statistical variance for control shrubs each year, and was responsible for the failure to find significant differences between topped and control shrubs.

### **Retopping**

In an earlier report by Ferguson and Basile (1966), the effects of topping were based upon the response of 15 topped and 15 untopped shrubs. Topping was accomplished the spring of 1960. Since 1963, occasional observations and several photographs have been made of these shrubs, but no quantitative data have been obtained. In March 1966, eight of the original topped shrubs were topped again. The new cutting was about 5 inches above the level of the original cut. During the summer of 1966, the retopped shrubs exhibited a flush of new twig growth similar to that which occurred after the first topping 6 years earlier. Figure 4 shows one of these retopped shrubs in the autumn of 1967, two growing seasons after retopping, and in July 1970, five seasons after retopping.

### **Longevity Following Topping**

Periodic observations of the 30 shrubs involved in the 1960 trial disclosed that by July 1970 only one shrub (untopped) had died. The estimated percent dead canopy averaged 22 percent for topped shrubs and 33 percent for untopped shrubs. Thus, topping does not appear to decrease longevity of old shrubs.

### **Seed Production**

Because topping removes one-third to one-half of the canopy from each shrub, cutting unquestionably decreases the production of seed from an old stand--and older bitterbrush shrubs often produce the largest quantities of seed. This decrease in seed production is most pronounced the first growing season after topping. From the second season on, seed production should increase rapidly, as flower buds are formed on branch wood.

### **Damage by Insects and Disease**

There is a possibility that wounds caused by topping serve as entrance points for disease, or attract wood-destroying insects. During this 4-year study on the Boise, Modoc, and Sawtooth sites, we observed no evidence that topping encouraged either disease or insect damage.

### **Safety Precautions**

The use of chain saws requires some safety precautions. Chain saw users should always wear protective chaps,<sup>1</sup> goggles, and sturdy gloves. Cutting with the top of the chain, instead of the bottom as one would be inclined to do, causes most of the debris to be thrown away from the sawyer, and also keeps the chain sprocket clean.

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<sup>1</sup>USDA Forest Service. Chaps, protective (for chainsaw operator), specification 6170-4a, 20 p. Northern Region, Missoula Equipment Development Center, Missoula, Montana. 1971.

A



B



Figure 4.--A, An overmature bitterbrush shrub, first topped in April 1960 and retopped March 1966. Photo (taken in November 1967) shows very good twig growth. B, in July 1970, 4 years after retopping, this shrub is still productive.

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1972. Bitterbrush topping: shrub response and cost factors, USDA Forest Serv. Res. Pap. INT-125, 11 p. (Intermountain Forest and Range Experiment Station, Ogden, Utah 84401.)

Ten-acre stands of overmature bitterbrush (Purshia tridentata (Pursh) DC.) shrubs were topped on the Boise, Modoc, and Sawtooth National Forests. Costs of topping and the effect on annual twig production during the next four years were evaluated. The effect of topping on shrub longevity is also discussed.

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Headquarters for the Intermountain Forest and  
Range Experiment Station are in Ogden, Utah.  
Field Research Work Units are maintained in:

Boise, Idaho

Bozeman, Montana (in cooperation with  
Montana State University)

Logan, Utah (in cooperation with Utah  
State University)

Missoula, Montana (in cooperation with  
University of Montana)

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